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de Koning R.E., van Nes A.

Department of Civil Engineering, Western Norway University of Applied Sciences
 Inndalsveien 22b, 5063 Bergen, Norway
 e-mail: REK@hvl.no, AVN@hvl.no

MORPHOLOGICAL ANALYSIS OF SETTLEMENTS IN THE ARCTIC: A COMPARATIVE ANALYSIS OF FOUR SETTLEMENTS WITH DIVERGING IDEOLOGIES ON SVALBARD

Abstract: The Norwegian archipelago of Svalbard contains the northernmost permanently inhabited settlements in the Arctic region. In this inquiry, comprehensive morphological analyses are made of the street network configuration, urban form and the functional distribution pattern to reveal the differences in four settlements built under the influence of two opposing political ideologies. The spatial tools used are Space Syntax and the Mixed-Use Index. The theory of the natural urban transformation process suggests that the spatial configuration of the street network guides urban developments. Along well-integrated streets, the building density and the mix of public functions tends to be higher than along segregated streets, which tend to be more monofunctional. The analysis reveals that political ideology influences the types and distribution pattern of building functions and types of artefacts. In capitalistic/liberated economy types of settlements, public functions along well-integrated streets consist of commercial facilities such as shops, bars, restaurants, Vinmonopolet (alcohol sales point), offices, educational, governmental and cultural institutions. Since commercial functions are lacking in (former) communistic/state-controlled economy types of settlements, it is housing, cultural and social facilities and Lenin's statue that are located along the most highly integrated streets.

Keywords: Arctic settlements, political ideology, Mixed-Use Index, Space Syntax.

Introduction: Two divergent ideologies, two established research traditions

How does political ideology influence the physical form of settlements? During the last century, the world was confronted and to some extent divided by two political ideologies: communism and capitalism. Shortly described, the communist ideology strives for equal ownership and the sharing of production (work, buildings, raw materials) and goods. As a counter reaction to capitalism, the idea is that common ownership and removal of the capital class reduces the social problems in a society. The state plays a major role in regulating the production mode and how the land is used (Bukharin, 1920). Conversely, a capitalistic ideology implies that facilitating the investment of money generates more working places, economic growth and more valuables for the people. The idea is that the distribution of goods and prices are regulated through a free market, and that it is private property owners who decide on investment and production mode (Hyman and Baptist, 2014).

The challenge was to find 'pure' examples of settlements influenced by these two ideologies, but not by any other outside influences. The opportunity to analyse four 'preserved' settlements that were subject to two divergent ideologies was found on Spitsbergen.

The archipelago of Spitsbergen was first discovered by the Vikings. On their way to Iceland, a Viking ship drifted away due to a heavy storm and ended up at Spitsbergen. The archipelago was named *Svalbardi*. Spitsbergen was rediscovered in 1596 by the Dutch explorer Willem Barentsz during an expedition to find a northern sea route to the Far East. Until the early nineteenth century, a few temporary whaling settlements were established by Dutch, Danish, English and French expeditions.

Russian expeditions, mainly for hunting walrus, whale and land mammals, commenced around the late eighteenth century. From the late nineteenth century, Spitsbergen became a destination for Arctic tourism, research and coalmining. With the Svalbard Treaty (Originally called the Spitsbergen treaty), full sovereignty was granted to Norway in 1925. In addition, the name of the archipelago was changed back to Svalbard.

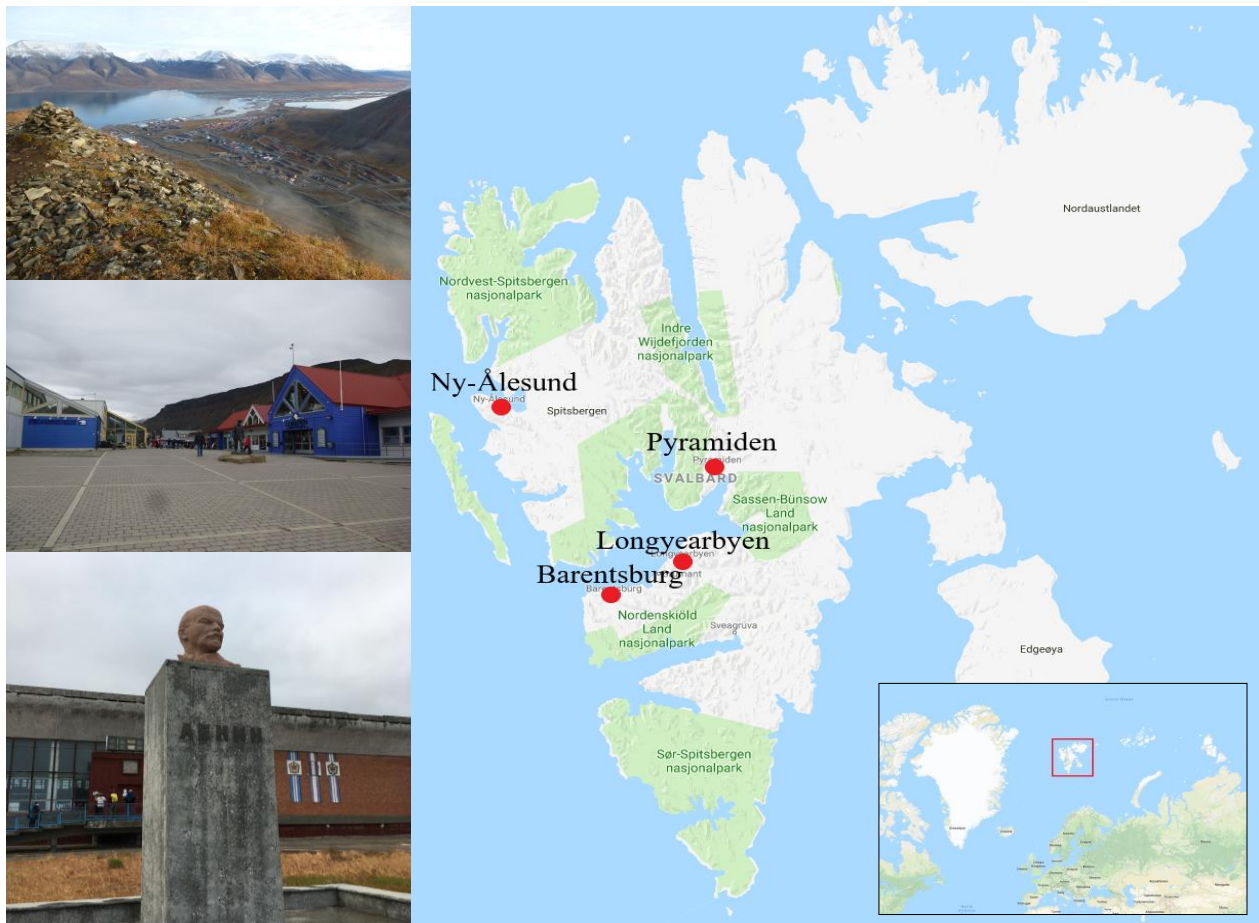


Figure 1. (left) Longyearbyen; main shopping street in Longyearbyen; northernmost statue of Lenin in front of the culture house in Pyramiden; (right) location of the four settlements on the archipelago of Svalbard.

Spitsbergen offers four ‘preserved’ cases that can reveal how a communist and a capitalist ideology affected the structure and pattern of the built environment. Two of these are Norwegian settlements: the ‘capitol’ Longyearbyen was founded as a coalmining town and is now a university town for Arctic research. Ny-Ålesund was a coalmining town and is today an international research settlement. The other two, Pyramiden and Barentsburg, are Russian coalmining towns, constructed during the former Soviet Union. In Pyramiden, the coalmining activities are closed down. This ‘ghost town’ is now a museum for tourism. Barentsburg is still an active coalmining town for the Russian Federation.

The four towns are separated from each other due to the extreme climate and political issues. In addition, individual travel on skis or hiking between these towns is a risky affair due to Svalbard’s 3000 polar bears ruling the nature just outside the towns. The limited possibilities to interact with each other make that each town has its own local community. Therefore, these four settlements represent unique cases for understanding the relationship between economic system, two diverging political ideologies, daily life and built form.

There are two well-established research traditions for analysing and understanding the relationship between society and its physical form: urban morphology and Space Syntax. In the urban morphology tradition, the main focus is on built form and meaning, i.e. the *extrinsic* properties of space: what kind of collective memory or meaning various artefacts in built environments have attached to them. Conversely, the Space Syntax tradition focuses on the spatial configuration of the spaces between the physical objects, or the *intrinsic* properties of space (van Nes, 2009). Whereas urban morphology has developed an understanding of how built environments' spatial patterns are shaped through changes in society (technical, social, political, ideological), Space Syntax has advanced our understanding of how the spatial structure influences the flow of movement and the location pattern of economic activities. This is also known as *the theory of the natural movement economic process*. These two research traditions are complementary. In an earlier research project on old towns and new towns, a quantification and combination of these two methods was applied (Ye and van Nes, 2014).

The theory of the natural movement economic process suggests that the largest flow of movement and the highest concentration of economic activities take place along the highest spatially integrated streets. (Global) spatial integration can be obtained by calculating the amount of direction changes needed to reach all other streets in a given network. The fewer direction changes one needs to get from one street to another, the higher its orientability and accessibility. Integration values are a numerical representation of this. In a free market society, shop owners will always locate their premises where most people move in order to reach as many customers as possible. These customers can be random through-travellers as well as the locals living in the vicinity. Therefore, high orientability and accessibility on various scale levels in a built environment are paramount (van Nes, 2005).

In a state-controlled economy, the incentive for shop owners to maximise their profits is lacking. Thus, the economic activity component of the theory of the natural movement economic process is distorted. Whereas in a free market economy, a market place generates capitalistic activities, in the communist ideology of Carl Marx, a practice was to locate dwellings and political institutions at the most integrated streets in city and town centres, for example in the rebuilding or regenerating of East Block cities during the Iron Curtain (van Nes, 2002: 276). In the physical division of Berlin between 1961 and 1989, housing and political institutions were constructed along the spatially integrated streets in East Berlin. After the reunion of Berlin in 1989, the ground floor functions inside these buildings were transformed back to shops (van Nes, 2009).

Theory and methodology

Over the last decades, Space Syntax research results worldwide have shown that the spatial configurational pattern of the street network guides the distribution of movement patterns as well as the allocation of functions such as shops, businesses and other public attractors (Hillier et al., 1993). Therefore, the Space Syntax method is useful to analyse street patterns and subsequently predict patterns of movement and (economic) activity.

Various methods are used to analyse the building morphology of a built environment (See for example: Berghauser Pont and Haupt, 2009, Carmona et al., 2010, Moudon, 1997, Rådberg, 1996, van Nes, 2003). The *Spacematrix* method is suitable for quantifying and classifying urban blocks according to the relationships between building density, height and land-use intensity (Berghauser Pont and Haupt, 2009, Rådberg, 1996). Yet another recently developed quantitative morphological method is *Mixed-Use Index* (MXI). This method is used to classify urban blocks and districts according to their percent share of function mix. A distinction is made between residential use, offices and amenities. The degree of blending of these three yields a classification in mono-functional, bi-functional and multi-functional buildings or areas (van den Hoek, 2009).

During the last years, GIS has proven a useful platform to combine Space Syntax, Spacematrix and MXI analyses of large regions. Based on a couple of examples from Europe and

Asia, the theory of the natural urban transformation process suggests that the spatial configuration of the street network guides urban developments. Along well-integrated streets, the building density and the mix of public functions tends to be higher than along segregated streets, which tend to be more mono-functional (Ye and van Nes, 2014). Hence, the spatial structure of the street network influences building density, degree of diversity of functions and therewith the degree of street life between buildings. How does this theory apply to isolated settlements under extreme climate conditions in the Arctic?

Due to extreme weather conditions and permafrost in the ground, there is no clear correlation between building density and degree of street network integration. Other factors, such as land slide risks and flooding risk in rivers during snow melting in summer, affect how and where buildings are located. Therefore, the main focus is on the relationship of the spatial integration of the street network with the distribution of functions and the location of symbolic values of artefacts, and not the relationship with building densities and form.

Longyearbyen

The largest permanently settled town and administrative centre of Svalbard, named after its founder, American entrepreneur John Munro Longyear, started as a coal company town. It has a permanent population of over two thousand inhabitants. The University Centre in Svalbard (UNIS) has around 690 students. Coalmining activities have been reduced in the last decades, but some traditions and artefacts connected to the coalmining are kept. Now, Arctic research and tourism are the main economic driving forces of Longyearbyen. Most people travelling to Svalbard arrive in the airport of Longyearbyen. Since there are no road connections from Longyearbyen to the other three towns, most transport between them take place by boat in summer, when the fjords are not frozen, or alternatively with helicopters or snow scooters. Transfer to and from Ny-Ålesund can also be carried out with small airplanes.

Due to permafrost, all buildings and technical infrastructure of the town are constructed on piles above the ground. The buildings are mostly wooden coloured in autumn leave colours such as red, yellow, orange and moss green, mirroring the short season when these colours are visible in the natural vegetation.

In the centre, there are some shops, an alcohol sales point (*Vinmonopolet*), tourist information, two bars and three restaurants, cultural house with a cinema and library, hospital (8 beds), the municipality house and university. Outside the centre, there is a sports facility with swimming pool, school, kindergarten, church, administrative buildings, community house (*huset*) and some restaurants accommodated in hotels. Closer to the harbour, we find the university, museums, and snow-scooter centre.

Fig. 2 shows a global integration analysis of Longyearbyen through the MXI analysis. In the most integrated spaces, coloured in red, the supermarket with *Vinmonopolet* is located. In general, a high degree of function mix is found along these most integrated streets. It is here where students, coal miners, researchers and tourists mingle for social contact and doing their shopping. The social life and leisure activities of Longyearbyen's inhabitants consist of informal visiting each other, going out to the pubs and arranged concerts, party in the common student kitchen, and outdoor activities such as cross-country skiing, hunting, hiking and going on tours with polar dogs. The locals are engaged in the local society. Some inhabitants have cottages outside the settlements a few kilometres away from the town, just to escape the social surveillance that follows from Longyearbyen's transparent society. Ny-Ålesund

At 78°55' N latitude, Ny-Ålesund is the northernmost permanently inhabited functional civilian settlement on Svalbard. Like Longyearbyen, it was founded as a coalmining settlement in 1917. With a permanent population of almost 30-35 and a summer population of 120, Ny-Ålesund functions today as a research settlement. It has been the starting point for several North Pole expeditions, commemorated by the statue of polar explorer Roald Amundsen (1872-1928).

Due to its location close to the Atlantic Gulf stream, the surroundings of Ny-Ålesund's have a rich variety of Arctic species.

Ny-Ålesund's buildings have the same colours and the same morphology as in Longyearbyen, but everything is on a smaller scale. The centre has a post office with a small souvenir shop and a kiosk (open once a week), and a small cafe located in the spatially most integrated street. These activities are both metrically and topologically in the most central position in this small settlement (Fig. 3). Ny-Ålesund furthermore has a small airport, museum and a number of research centres.

Longyearbyen

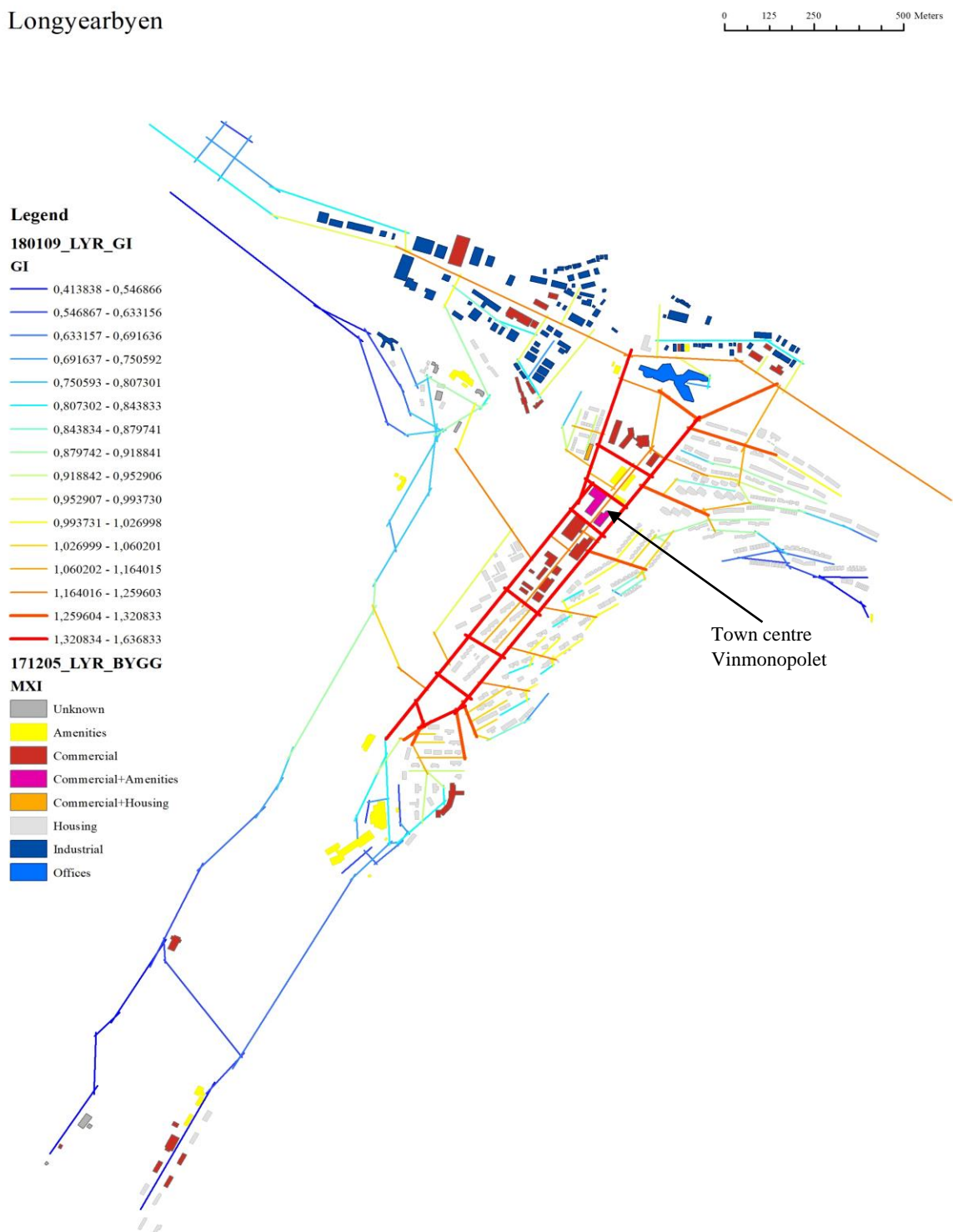


Figure 2. Global integration map with the MXI of Longyearbyen

Ny-Ålesund

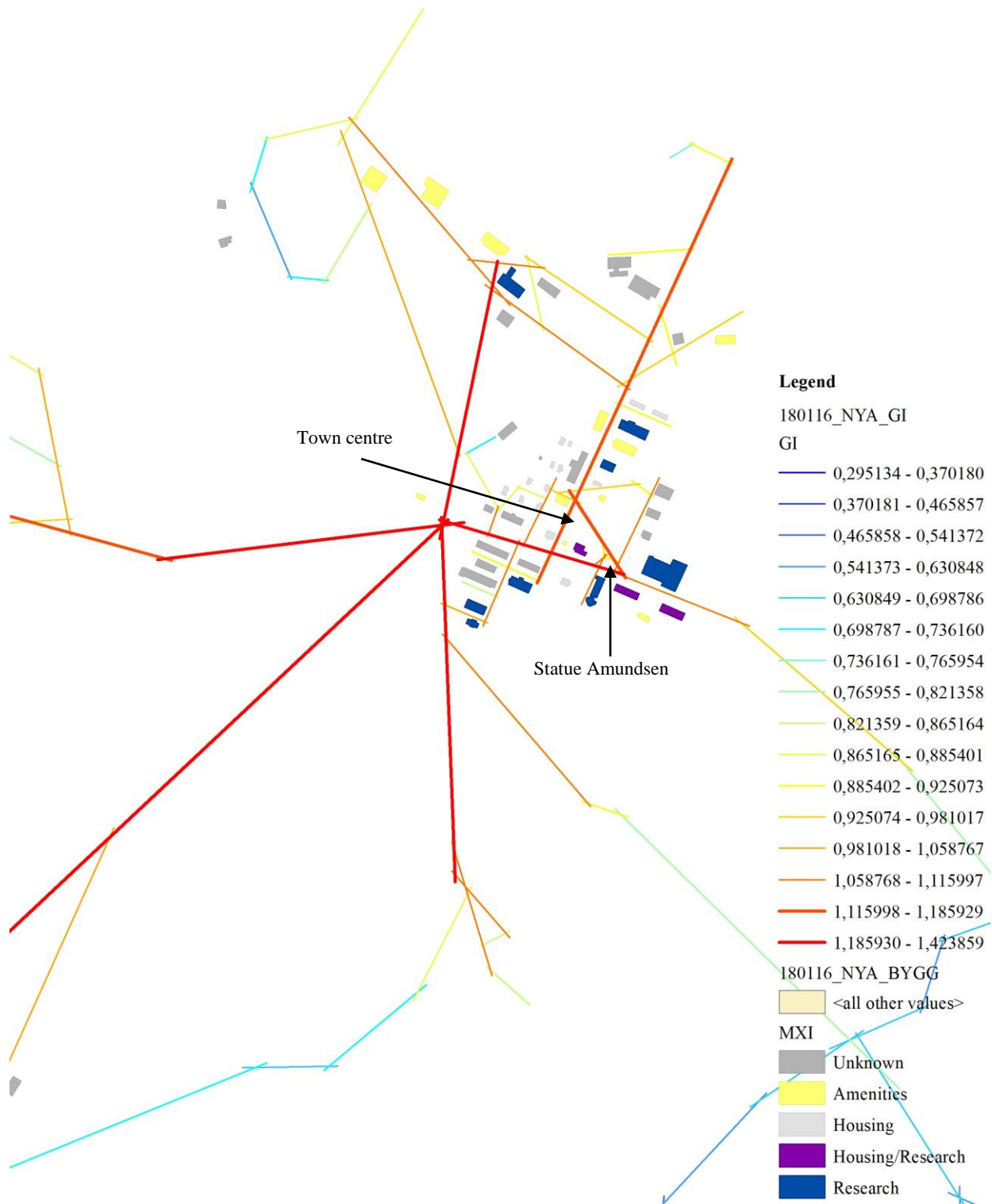


Figure 3. Global integration map with the MXI of Ny-Ålesund.

Since there are no daily shopping possibilities in Ny-Ålesund and all the food is prepared in the 'Messa', the social life has many similarities with that in the Russian settlements. The only shopping may consist of buying sweets, cigarettes and newspapers from the local kiosk once a week or when the cruise ships arrive. The leisure activities are cross-country skiing, hunting and hiking with the dogs. The pub is open one or two evenings per week. Inside the sports facility, the locals can do various sports activities. The old coalmining company *Store Norske Kompaniet* owns the ground and rents it out to the research institutes. This company also arranges tours to and from Ny-Ålesund and supplies the food for both inhabitants and visitors.

Pyramiden

The name of the northernmost Russian settlement on Svalbard, Pyramiden (Пирамида), was inspired by the distinctive shape of the mountain next to it. Founded in 1910, the Pyramiden concession was sold to the Soviet Union in 1927 by Sweden. The population peaked at around 1200 inhabitants before it was closed down in 1998 after the dissolution of the Soviet Union. Since the abandoned town was resettled for touristic purposes in 2007, Pyramiden has around three to six inhabitants in winter and fifteen in summer. Pyramiden can be reached by boat during summer or by a 120 km snow scooter trip from Longyearbyen in winter.

The buildings of Pyramiden and its content are left, representing a 'pure' example of a town constructed according to the communist ideology during the Soviet Union. Interestingly enough, the same colour palette is used on Pyramiden's buildings as in the other settlements. However, the architectural ornaments in the old cog-jointed timber houses built before the 1970s have influences from traditional Russian wooden architecture. In the 1970s and 1980s, several brick houses were built. The shape of these 2 – 4 floors blocks has the same architectural expression as the modernist movement's, which influenced the Soviet built environments after the 1960s.

In the past, the town offered luxurious leisure facilities to its inhabitants. It had a cinema, swimming pool, sports and ballet facilities, music rooms and arts and crafts rooms. Fig. 4 shows the spatial integration of Pyramiden's street network combined with the functions of buildings. At the most integrated space, a statue of Lenin is located, showcasing one of the leaders of the Soviet communist ideology. Most of the administrative buildings, sports- and community activities used to take place along the spatially most integrated streets. Likewise, the cantina is located adjacent to the spatially integrated square. The rooms and apartments are not equipped with a kitchen. All meals were made and eaten in the cantina. Therefore, Pyramiden had no shops. Today, there is a small post office selling some souvenirs inside the (more recent) hotel.

The social life in Pyramiden consisted of art, dance, music, sports and community activities. They kept some cows to make their own butter and milk. Apart from the arranged activities by the state, the locals had informal private parties in their apartments.

Barentsburg

Founded in the 1920s by the Dutch, the Barentsburg (Баренцбург) coal concession was sold to the Soviet Union in 1932. During the last decade, the population dropped from 1000 to 500 inhabitants. Due to political interests and its geographically strategic position, the Russians want to keep the coalmining activities in Barentsburg, even though it is no longer profitable. Most visitors to Barentsburg arrive to Longyearbyen by plane and take the 55 km boat trip along the fjord in summer. In winter, Barentsburg can be reached from Longyearbyen by a snow scooter or helicopter. Until the dissolution of the Soviet Union, there were no shops in Barentsburg. Free food for the workers was transported to the cantina from the Soviet mainland. Today, there is one souvenir shop for tourists located along the most integrated street. Like Pyramiden, Barentsburg centre has the same types of buildings with the same spatio- functional organisation, as well as a statue of Lenin at its most integrated space. Fig. 5 shows a spatial integration analysis with the degree of function mix for Barentsburg. All community activities – the sports centre with a swimming pool, the cantina and administration buildings – are located along the most integrated

space. The relatively new souvenir shop is also located nearby, between the ferry mooring place and the most integrated space. The daily life for Barentsburg's inhabitants still has the same structure as during the Soviet period. Informal parties take place inside the apartments, whereas the arranged social, cultural, sports and community activities take place inside the buildings provided by the state.

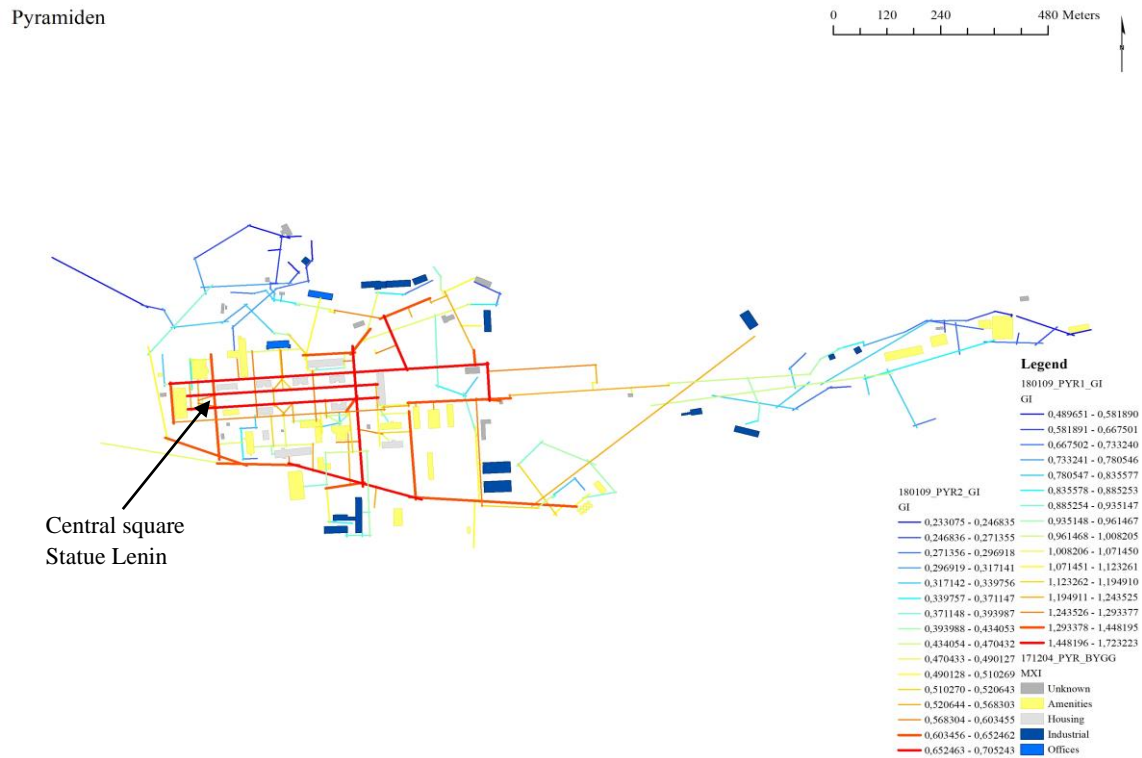


Figure 4. Global integration map with the MXI of Pyramiden

Currently, Barentsburg is the best preserved communist community that still exists, both in terms of the way of living and in its spatial arrangement.

The relationship between urban space and political ideology

What is then the relationship between space and ideology? Both in the two Norwegian settlements and the two Russian ones, the functional mix is high along highly integrated streets. Buildings are monofunctional along the remaining segregated streets. However, whereas in the Norwegian settlements Longyearbyen and Ny-Ålesund, the buildings along highly integrated streets contain commercial functions (restaurants, bars, shops, and the alcohol sales point *Vinmonopolet*), such commercial functions are lacking in the former Soviet settlements Pyramiden and Barentsburg. Instead, political and cultural functions in line with the communist ideology are located along the highest integrated streets, such as the community and culture house, cantina, school, and the *statue of Lenin*. Perhaps the main issue for shop owners in the Norwegian settlements is to generate income from selling alcohol, food, clothing, kitchenware and outdoor equipment from the locals' as well as tourists' money. Conversely, regarding the Russian settlements, the statue of Lenin stands as a reminder that the state takes care of its members. The state provides the people with amenities, while the workers' production generates income for the state and the welfare of everyone.

Obviously, the theory of the natural urban transformation process suggests that the configuration of the street network guides the distribution of functions and building densities. To a large extent, the highest number of floors and the highest variation of non-residential functions are found in buildings in the centre of these four Arctic towns.

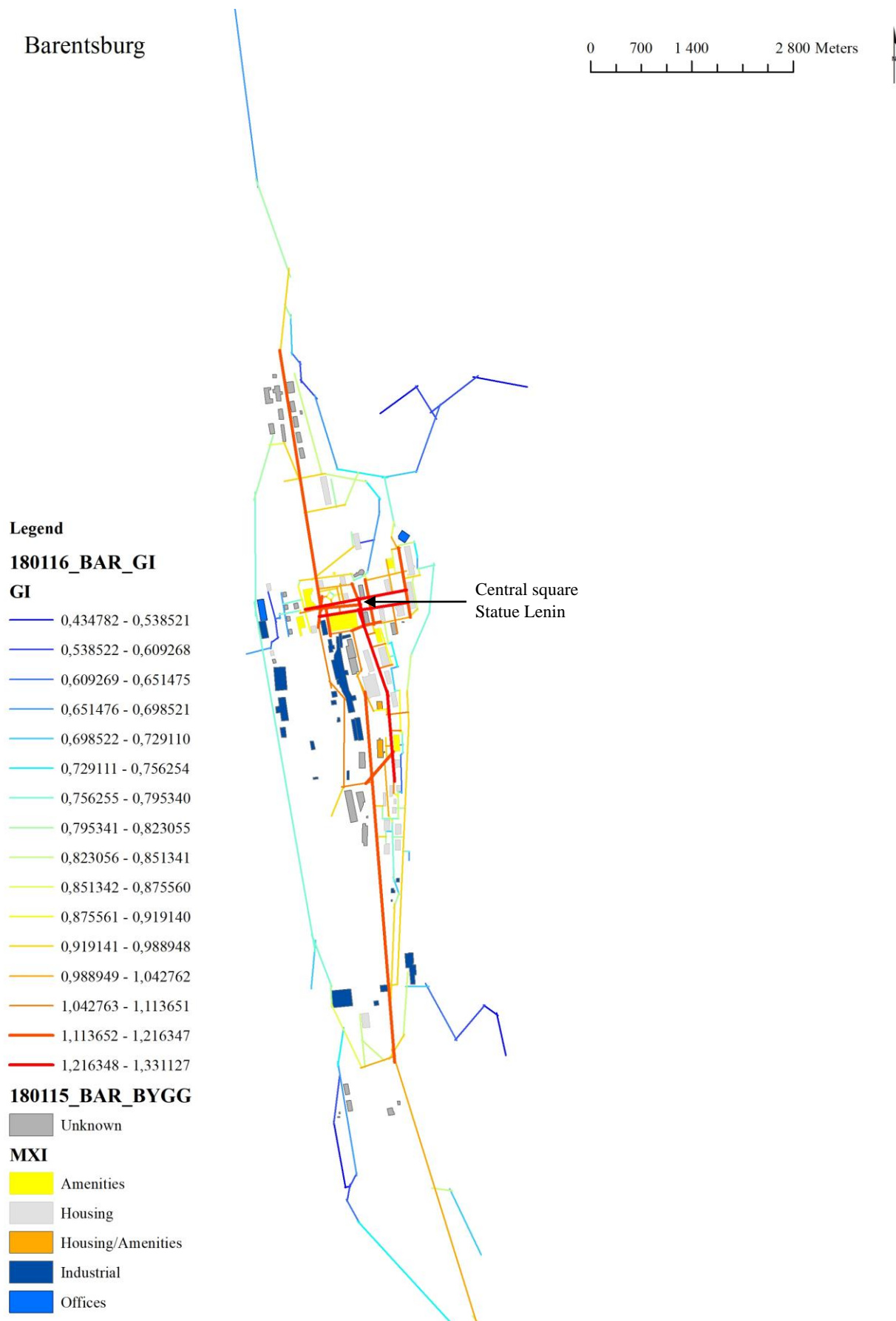


Figure 5. Global integration map with the MXI of Barentsburg

All four towns were originally planned as coalmining company towns. However, the coal miners took their families with them. In the past, before the airport was built, travelling to and from these towns could only take place in summer by boat when the fjords were not frozen. Therefore, these settlements have been isolated from each other, and have been steered centrally from two different nations with different ideologies. Human beings are social beings, and therefore social activities were organised in each local community. Therefore, the division of functions used in the MXI method turned out to be useful in all four towns. The method has been criticised to be weak regarding the definition between shops and amenities. However, its broad definition turned out to be useful in the comparison between settlements based on different ideologies.

How then does ideology influence space use? Where free market ideology rules, the mechanism of profit maximisation leads to searches for the optimal location to reach as many customers as possible. The public leisure activities in the Norwegian settlements are shopping and meeting people at the restaurants, bars and cafes. In particular, Longyearbyen has a high number of outdoor equipment shops. That is what inhabitants spend their money on in their leisure time. In settlements with a state-controlled economy, there is no incitement for profit maximising. Coalmine workers and their families got free food supply from the main land and free housing from the state, even though coalminer salaries were high. These as well as the spatial conditions encouraged workers to participate in the locally organised sports and culture activities.

In general, political ideology influences what kinds of functions or artefacts are located along the spatially most integrated streets. In a capitalistic society, shopping activities take place, whereas in a communistic society, political and state-controlled community activities take place along the town's most spatially integrated streets. The comparative analysis of settlements in the Arctic that was presented in this paper has demonstrated that the theory of the natural urban transformation process can be corroborated irrespective of political ideology.

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